

NON-DESTRUCTIVE CLASSIFICATION APPROACHES FOR EQUILIBRATED ORDINARY CHONDRITES.

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Introduction: Classification of meteorites is most effectively carried out by petrographic and mineralogic studies of thin sections, but a rapid and accurate classification technique for the many samples collected in dense collection areas (hot and cold deserts) is of great interest. Oil immersion techniques have been used to classify a large proportion of the US Antarctic meteorite collections since the mid-1980s [1]. This approach has allowed rapid characterization of thousands of samples over time, but nonetheless utilizes a piece of the sample that has been ground to grains or a powder. In order to compare a few non-destructive techniques with the standard approaches, we have characterized a group of chondrites from the Larkman Nunatak region using magnetic susceptibility and Mössbauer spectroscopy.

Samples: Samples were selected from groups of ten characterized and announced in the Spring 2008 newsletter (LAR 06470-479; 06500-509; 06570-579; 06820-829; [2]). After photographing, weighing, and describing the samples (as usually reported in the newsletter) we measured magnetic susceptibility while the samples were bagged, using the approach of [3]. Small chips for purposes of oil immersion classification were then sent to the Smithsonian as part of the standard classification and characterization, whereas the main masses of each were placed on a Mössbauer detector set up in backscattering geometry to acquire spectra for interpretation as well [4]. Finally, thin sections of each chondrite were produced and olivines analyzed using a Cameca SX50 at NASA-JSC.

Results: Microprobe analyses revealed there are 8 L, 11 LL, and 21 H chondrites. There is a very clear trend between the olivine Fa content (mole %) and the magnetic susceptibility values. Furthermore, the magnetic susceptibility values for the LL chondrite are all within well-defined ranges and agree well with the microprobe data. However, the H and L chondrite boundary was less clear with the magnetic susceptibility values, making it difficult to resolve these two groups near their boundary. On the other hand, Mössbauer spectroscopy allowed clear resolution of H from L and LL chondrites, based on the ratio of olivine area ratio (%) to kamacite + nanophase iron oxide + hematite area ratio (%), but no resolution of L and LL chondrites. The combination of Mössbauer spectroscopy and magnetic susceptibility can resolve all three groups very well, and may be a useful approach for truly non-destructive analysis.

References: [1] Lunning, N. et al. (2012) 43rd Lunar and Planetary Science Conference, #1566; [2] Satterwhite, C.E. and Richter, K. 2009 Ant. Met. Newsletter 32, no. 2; [3] Folco, L. et al., (2006) *Meteoritics & Planetary Science* 41, Nr 3, 343–353. [4] Klingelhöfer, G. et al. (2003) *J. Geophys. Res.* 108(E12), 8067, doi:10.1029/2003JE002138.